# Conservation Agreement for *Puccinellia howellii*

**National Park Service**
**Whiskeytown National Recreation Area**

**December 2005**

***Puccinellia howellii* Site**
**Circa 1890**

## SIGNATORIES

**U.S. Fish and Wildlife Service**

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Name Date

**National Park Service**

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Name Date

**California Department of Transportation**

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Name Date

**California Department of Fish and Game**

_____

Name Date

# Errata

In Conservation Agreement for *Puccinellia howellii*, May 2005
Corrected in December 2005 version

Consensus changes agreed upon by the members of the *Puccinellia* Interagency Conservation and Restoration Group (National Park Service, Whiskeytown Recreation Area; U.S. Fish and Wildlife Service, Red Bluff Office; California Department of Transportation, Region 2; California Department of Fish and Game, Northern California and North Coast Region). January 25, 2006.

Key to page identifiers. Every error corrected is associated with and ordered pair below; having the following generalized structure (a[x], b[x]). The a value refers to the page number in the May 2005 version; while the b value refers to the page number for the December 2005 version; values in square brackets are used when that correction occurs more than once on a given page.

Pages (2,4) (4, 7), (6 [2x], 10 [2x]) (11 [2x], 17 [2x])
Insert 'West' after 'Highway 299'

Page (3, 6)
Insert '(2001)' after 'National Park Service Management Policies'

Page (8,12)
Replace 'if' with 'it' topmost paragraph, fourth line

Page (12, 17)
Insert 'U.S.' before 'Army Corps of Engineers…' last paragraph

Page (14, 20)
Correct spelling of '*thaspus*' to '*thapsus*' last paragraph

Page (14, 21)
Replace '*P.*' with '*Puccinellia*' second paragraph where it leads sentence
'P. howellii establishes in coarse gravel…'

Page (15, 22)
In last paragraph, sentence in fourth line, begins 'Spring 1 is a popular area… of shotgun shells…' Sentence will be terminated with period after the word 'shells'; following 'shells' the word 'and' is deleted and replaced with 'Also' which become the start of new sentence 'Also, in October 2000, …'

Page (15, 22)
In second Discussion paragraph, reference identified as '(California Water Quality Control Board, 1985)' is deleted and replaced with the correct citation of '(Department of Water Resources, Northern District, 1985)'

Page (16, 2)
Signature page moved from p. 16 to p. 2, and "XI" deleted from page, hence XII is now XI, XIII is now XII, and XIV is now XIII.

Page (17, 24)
Reference identified as 'Water Quality Control Board, Central Valley Region. 1985. …' is re-cited as 'Department of Water Resources, Northern District. 1985. …' and moved to page 22 into alphabetical sequence.

# Conservation Agreement for *Puccinellia howellii*
# December 2005

## I. INTRODUCTION

*Puccinellia howellii* (Howell's alkali grass) is a short-lived, perennial, obligate wetland alkali grass that is found in a complex of mineral springs along California State Highway 299 West, in Shasta County, California. *P. howellii* was recognized as a distinct species in 1990. No additional populations have been identified anywhere else to date. The springs are of considerable importance to wildlife and have been listed by the State of California as a Significant Natural Area (SHA-41). The *P. howellii* population occurs on land owned by the State of California and the United States of America, largely within the California Department of Transportation (Caltrans) right-of-way in Whiskeytown National Recreation Area, a unit of the National Park Service (NPS).

## II. OBJECTIVE AND INTENT

This action is undertaken to conserve *P. howellii*. The objective and intent of this Conservation Agreement is to preclude the need to list *P. howellii* by the following actions:

1) Identify threats, goals, and action items.
2) Minimize threats to *P. howellii* and habitat to the extent practicable.
3) Stabilize and ensure integrity of the *P. howellii* population.
4) Restore and preserve the *P. howellii* mineral springs habitat.
5) Improve the status of *P. howellii* through expansion of the extant population, discovery of additional extant populations, or the establishment of new sustainable populations.

Specific goals, threats, conservation and recovery measures, and action items are identified in Section IX and Appendix I. Implemented actions will protect and conserve this species. This Conservation Agreement will help clarify the legal responsibilities of the involved partners. This agreement is entered into in a spirit of mutual respect and cooperation between the involved partners in order to enhance the protection and conservation of *P. howellii*. If the objectives of this Conservation Agreement are not met, *P. howellii* may be considered for State listing by the California Department of Fish and Game (CDFG) and may be considered for Federal listing by the U.S. Fish and Wildlife Service.

## III. CURRENT MANAGEMENT

There is no formal management of the *P. howellii* population at present. Existing land uses in the vicinity include hunting and gold panning and the transportation corridors of Highway 299 West and Crystal Creek Road. The development of this Conservation Agreement will define actions that are anticipated to stabilize the population and define management and recovery actions for the next five years. Agencies involved in planning and implementing management and conservation or recovery actions include the California Department of

Transportation, California Department of Fish and Game, U.S. Fish and Wildlife Service, and National Park Service. The California Native Plant Society is involved in a consultant capacity.

## IV. PARTIES TO THE CONSERVATION AGREEMENT

National Park Service
Whiskeytown National Recreation Area
P.O. Box 188
Whiskeytown, CA 96095
Contact Gretchen Ring (530) 359-2368 or Jennifer Gibson (530) 242-3457

California Department of Transportation
District 2
1657 Riverside Drive
Redding, CA 96001
Contact Sharon Stacey (530) 225-3513 or Jonathan Oldham (530) 225-3308

California Department of Fish and Game
601 Locust
Redding, CA 96001
Contact Rich Lis (530) 225-2142 or Craig Martz (530) 225-2281

U.S. Fish and Wildlife Service
10950 Tyler Road
Red Bluff, CA 96080
Contact Ron Clementsen (530) 527-3043 or David Imper (707) 822-7201

Each party will notify the other parties in writing of any changes in the contact individuals for this Conservation Agreement.

## V. AUTHORITIES FOR CONSERVATION AGREEMENTS

U.S. Fish and Wildlife Service Authority

The authority for the U.S. Fish and Wildlife Service to enter into this voluntary Conservation Agreement derives from the Endangered Species Act of 1973, as amended (ESA).

California Department of Fish and Game Authority

The authority for the California Department of Fish and Game to enter into this voluntary Conservation Agreement derives from State of California regulatory chapters 2700, 2701, and 2702, which are excerpted below.

Chapter 2700 shall be known…and…cited as the Wildlife and Natural Areas Conservation Act. The fundamental requirement for healthy, vigorous populations of fish and wildlife is habitat. Without adequate habitat, efforts to conserve and manage fish and wildlife resources will have limited success. Further, California contains the greatest diversity of wildlife and plant species of virtually any state in the nation… The public interest is served only by ensuring that these resources are preserved, protected, and propagated for this and future generations.

(a) Many of California's wildlife, fish, and plant species and biological communities are found nowhere else on earth. Without adequate protection and management, rare native species and communities could easily become extinct...

(b) The people of California have vested in the Department of Fish and Game the principal responsibility for protecting, conserving, and perpetuating native fish, plants, and wildlife, including endangered species and game animals, for their aesthetic, intrinsic, ecological, educational, and economic values. To help accomplish this goal, the people of California have further established a significant natural areas program…in the Department of Fish and Game, which is charged with maintaining and perpetuating California's most significant natural areas for present and future generations.

National Park Service Authority

Although *P. howellii* is not currently listed as threatened or endangered by the State of California or the Federal Government, NPS policy mandates that sensitive species be treated as if they were listed species. This policy is consistent with the statutory duty of the NPS to conserve the scenery, natural and historic objects, and wildlife in national parks and monuments by such means as will leave them unimpaired for future generations (National Park Service Organic Act; 16 U.S.C. 1.)

National Park Service Management Policies (2001) state:

> The National Park Service will identify and promote the conservation of all federally listed threatened, endangered, or candidate species within park boundaries and their critical habitats...The National Park Service also will identify all state and locally listed threatened, endangered, rare, declining, sensitive, or candidate species that are native to and present in the parks, and their critical habitats... Management and monitoring programs should be coordinated with other State and Federal agencies.

Major NPS program objectives include:

> 1. Inventory and monitor sensitive, candidate, and listed species. This includes mapping species distribution in the park, identifying critical

habitats, and determining numbers of individuals, threats to the species, condition, and population trends.
2. Manage endangered, threatened, and candidate species, and their critical habitats, in conformance with the Endangered Species Act, recovery plans, and other appurtenant documents.
3. Ensure that park operations do not adversely impact endangered, threatened, candidate, or sensitive species and their critical habitats, within or outside the park.
4. To the extent possible, ensure that activities, projects, or programs outside the park do not adversely impact endangered, threatened, candidate, or sensitive species and their critical habitats within the park.
5. Integrate to the fullest extent possible park management actions with other Federal, State, and private recovery efforts.
6. Ensure appropriate consideration of Federal and State listed species and other special status species in all plans and National Environmental Policy Act documents.
7. Encourage NPS involvement on recovery teams as appropriate.
8. Design and implement research relevant to the preservation of candidate, rare, sensitive, and listed species.
9. Thoroughly document recovery actions and considerations.

Other guidance may be obtained from the legislation cited in Authorities, above, from species recovery plans, NPS-2, the Planning Process guideline; NPS-12, the Environmental Compliance guideline; NPS-18, the Fire Management guideline; NPS-20, the Federal Assistance and Interagency Agreement guideline; NPS-28, the Cultural Resources Management guideline; NPS-53, the Special Park Uses guideline; and NPS-9, the Law Enforcement guideline.

California Department of Transportation Authority

The authority for the California Department of Transportation to enter into this voluntary conservation agreement derives from the National Environmental Policy Act of 1969 and the California Environmental Quality Act of 1973, as well as their responsibility to manage the resources found within the state transportation corridor.

## VI. DURATION and INTENT OF CONSERVATION AGREEMENT

The duration of this Conservation Agreement is intended to be five years from the date the document is signed by all parties. The Agreement is a dynamic adaptive management tool that can be modified by agreement of the parties to reflect the changes deemed necessary based on the acquisition of new information. The Agreement can be revised at any time or renewed at the end of the five-year term by agreement of all parties. The renewed Conservation Agreement will incorporate a new literature review, results of research completed over the five-year term of the Agreement, and appropriate conservation measures based on the new information. Meetings to discuss urgent situations

can be called by any of the partners to this agreement as often as necessary. Nothing in this Conservation Agreement shall be construed as obligating any of the parties to expend funds in excess of appropriations authorized by law. The parties intend to pursue funding as opportunities arise. This Agreement may be terminated by written agreement of the parties.

## VII. SPECIES DESCRIPTION, BIOLOGY, AND ECOLOGY

*Puccinellia howellii* was first collected in April 1954 by John Thomas Howell and Lewis S. Rose in a mineralized seep near the junction of Highway 299 West and Crystal Creek Road in Whiskeytown National Recreation Area, Shasta County, California (Figure 1). Howell noted that the plants could not be readily assigned to any previously described species, but neither he nor consulting botanists described it as a new taxon. Dr. Jerrold Davis with Cornell University described the grass as a new species in 1990 (Davis, 1990).

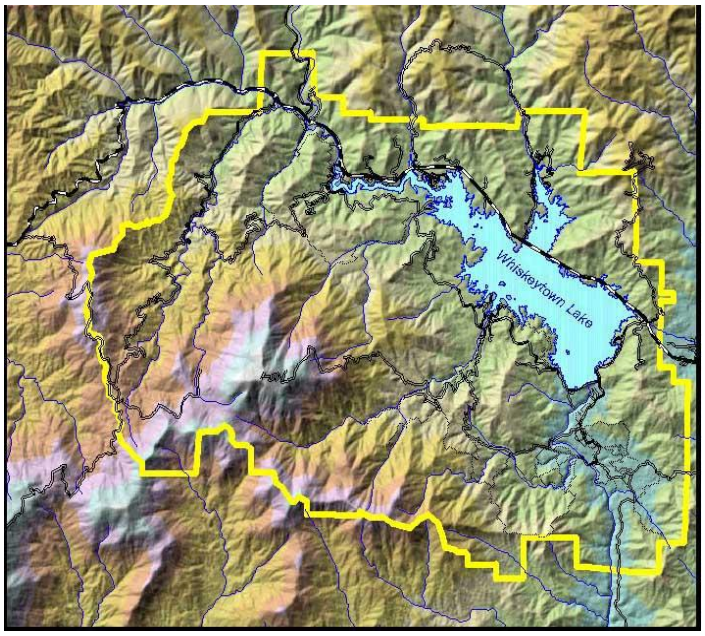

Figure 1 Whiskeytown National Recreation Area

*Puccinellia howellii*, a member of the Grass Family (Poaceae) is a perennial, tufted, nonstoloniferous herb, with both basal and cauline leaves (Figure 2). Flowering stems are erect to ascending, ranging from 7-40 cm tall. The leaf sheaths are open nearly to their bases. The leafblades are involute and 1.4-2.2 mm wide when unrolled. The panicles are 2-13 cm long and relatively narrow. The ultimate panicle branches and pedicels are glabrous or subglabrous with a few scattered scabrules. The spikelets are 3.0-7.5 mm long and generally 2-5 flowered. The ovate glumes are minutely and uniformly scabrous-serrate near the apices, with entire margins below. The first glume is 0.8-1.9 mm long and one-nerved, while the second glume is 1.7-2.5 mm long and usually three-nerved. The lemmas are ovate to elliptic and usually convex with 5 obscure nerves. Like the glumes, the lemmas are minutely and uniformly scabrous at the apices and entire below. The lower lemmas are 2.4-3.3 mm long. The paleas

are subequal to the lemmas, two-keeled, glabrous below and glabrous or scabrous near their apices. The lower florets have three anthers that are 1.5-2.0 mm long. The caryopses are ovoid and 1.5-2.0 mm long (Davis, 1990).

Figure 2 *Puccinellia howellii*

*Puccinellia howellii* is unquestionably a distinct species in that it is not an unusual form or variety of a known species (Davis, 1993). *Puccinellia howellii* most closely resembles *P. pumila* according to Davis (1990). *Puccinellia howellii* and *P. pumila* differ from other species of *Puccinellia* occurring in California due to their perennial habit, glabrous or subglabrous pedicels, and palea keels that are glabrous along the lower half. *Puccinellia howellii* differs from *P. pumila* in that the margin of the lemma near the apex is minutely scabrous-serrate in *P. howellii*; and entire, or subentire with a few scattered scabrules in *P. pumila,* and the anther length is 1.5-2.0 mm in *P. howellii* and 0.5-1.0 mm in *P. pumila*.

Davis (1993) found that *P. howellii* has a high degree of genetic diversity between individuals. This is unusual in that much lower diversity would be expected in a single population if it established as a result of an isolated dispersal event. Secondly, polyploid species tend to have very low genetic variation; *P. howellii* does not conform to this usual pattern. Further, the population possesses unique alleles not found in other *Puccinellia* species (Davis, 1993).

An autecological study (Fulgham et al., 1997) of *P. howellii* conducted from 1993-1995 provided the initial information on the biology and ecology of *P. howellii*. Germination and growth of *P. howellii* at different salinity levels demonstrated that germination occurs sooner in fresh water and is delayed as salinity increases, although total germination in fresh and saline spring water was about the same. Greenhouse studies and field observations show that the seed has no problem germinating in undiluted spring water. It was noted that the first strong

pulses of germination began in mid to late summer, but only in locations where the seed was immersed in flowing water. Germination elsewhere was postponed until after the fall or winter rains. The length of the delay in germination was roughly proportional to the amount of summer salt accumulation. Foliar growth was greatest at a moderate salinity level. Germination tests at the Berry Botanic Garden revealed high germination percentages under a variety of conditions (Center for Plant Conservation, 2004).

## VIII. STATUS, DISTRIBUTION, AND ABUNDANCE OF THE SPECIES

This perennial grass is known from only one population located in three mineral springs along Highway 299 West in Whiskeytown National Recreation Area, in Shasta County, California. Despite extensive surveys of similar mineral spring habitats in northern California, no additional *P. howellii* populations have been found (State of California Department of Transportation, n.d.). A Caltrans Highway 299 West curve realignment project in 1992 eliminated 1,200 square feet of the springs and 2.9 percent of *P. howellii* cover. Additionally, a small wetland was lost and the hydrology of the springs may have been altered.

The *P. howellii* population is unevenly distributed within a complex of mineral springs at an elevation of approximately 1,350 feet along a 1,200-foot reach of Willow Creek (Figure 3). The three springs are noncontiguous on the surface but may represent a contiguous underground aquifer in fractured Copley greenstone. For reference, the individual springs have been assigned numbers. Springs 1 and 2 are located west of Crystal Creek Road, with Spring 2 being nearest to Crystal Creek Road (Figure 4). Spring 3 is located to the east of Crystal Creek Road.

This type of mineralized habitat is not unusual for *Puccinellia* species, most of which are endemic to saline or alkaline soils (Hickman, 1993). The approximate total area of the mineral springs in 2003 measured 69,621 square feet. Spring 1 measured 27,674 square feet, Spring 2 encompassed 36,544 square feet, Spring 3 measured 3,692 square feet, and the Roadside Spring covered 1, 722 square feet.

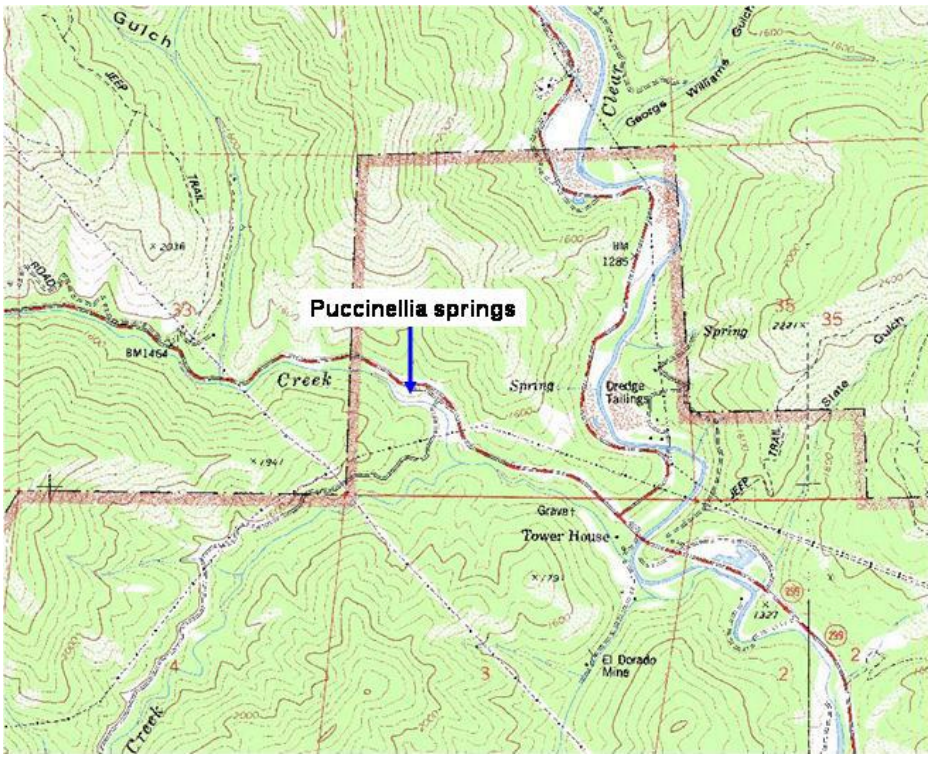


Figure 3 Mineral springs habitat of *Puccinellia howellii* indicated by the arrow

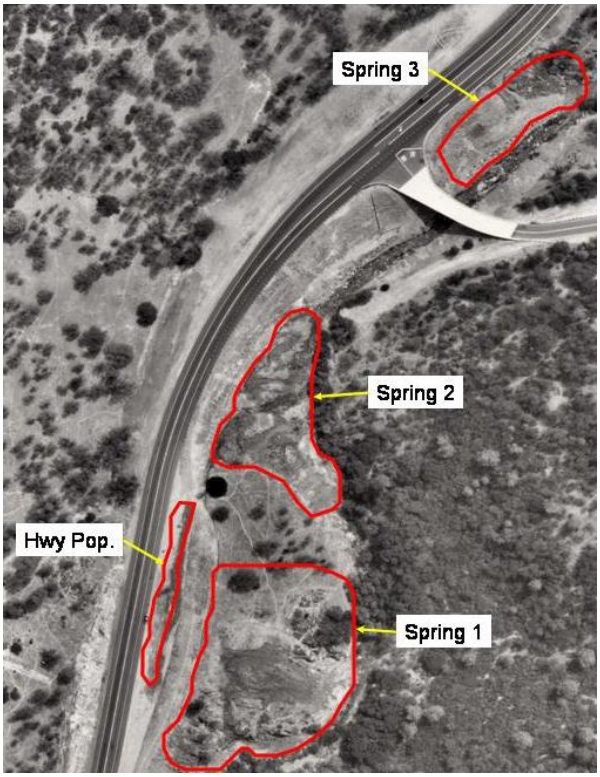


Figure 4 Approximate delineation of springs 1, 2, and 3

The springs discharge from numerous points, producing a sheet flow over much of the site as the water moves downhill. Salinity ranges from 15-35 dS/m

(mmho/cm), approximately half that of sea water, with a calcium content of 1 - 1.8 g/liter. Discharge volume and chemistry remain stable year-round (Casey, 1994; CH2M HILL 1991-1992; Stacey, 1999). Though initially alkaline with pH 9-9.6, the water acidifies to pH 7-5 as it flows away from the discharge points (Fulgham et al., 1997) presumably due to the influence of decomposing organic matter (Levine et al., 2002).

The distribution and abundance of *P. howellii* in the three springs were studied by Caltrans (Martz and Villa, 1990) and Fulgham et al. (1997). The dense growth habit of the species precludes estimations of the number of individual plants, and statistically robust data are not available to determine the population trends of these sites. However, *P. howellii* appears to be in decline in portions of Springs 1 and 2, and holes have been dug into Spring 1 which may represent recreational mining activity. During the past few years (2001-2004), large previously robust patches (~1m x 2m) have declined and died with regularity for unknown reasons.

A new colony of *P. howellii* gradually appeared over the past few years (1997-2003) on a wide pullout between Highway 299 and Spring 2 following the realignment project (Figure 5). This site may represent an extension of Spring 2, or the road realignment may have altered the hydrology of the area and created new habitat for *P. howellii*. The distance from this site to the highway ranges from 3 to 7 meters, and the site is routinely disturbed or damaged by vehicles driving and parking on it. Litter is almost always found on-site, including substances such as motor oil and other potentially toxic substances. Anecdotal observation of the large dead patches in recent years, which seem to be increasing in number, would indicate that the overall percent cover of *P. howellii* is in decline, in spite of the addition of the roadside population.

Figure 5 Wide pullout immediately above spring 1

*Puccinellia howellii* stands range from individual tufts that may be short or tall (Figure 6) to monotypic stands which have a dense turf-like growth (Figure 7). Another distinct type consists of dwarf tufts, scattered stands of apparently mature individuals reaching a maximum height of one inch in substrate that is wet year-round. Areas with greater soil accumulation and a more permanent supply of mineralized water tend to support the dense, nearly monotypic stands. *Puccinellia howellii* cover in the high density stands (51.8 percent) is substantially higher than in the low density stands (13.6 percent) (Martz and Villa, 1990).


Figure *6* Individual tufts may be short or tall

Figure 7 Monotypic turf-like form

*Puccinellia howellii* tends to occupy the central portions of the springs, often intermingled with *Triglochin maritima* in the wetter locations (Levine et al., 2002). These central portions of the springs remain saline during the rainy season (Figure 8), effectively excluding glycophytes during the period of active *P. howellii* growth. Salinity rises only moderately during the summer, permitting late summer to early fall germination by *P. howelli. Distichlis spicata* is often found at the periphery or at elevated areas within the springs adjacent to the surrounding non-saline vegetation where the influence of the discharge is less direct. Wicking and evaporation promote hypersalinity in these peripheral or elevated areas during the summer, however in winter and spring, when *Distichlis spicata* is dormant, the decrease in salinity promotes a sparse to dense cover of annual grass species found outside the springs. *Juncus bufonius*, an annual glycophyte, seasonally occupies some otherwise barren areas within the springs. The areas occupied by these vegetation types may shift somewhat over time in response to changes in the pattern of seepage and surface flow. Additional associated wetland species present in lesser amounts include *Polypogon monspeliensis* and *Spergularia marina* (Martz and Villa, 1990). Plant species found on the site are listed in Appendix II.

Figure 8 Central portion of springs retains salinity in rainy season

In addition to suitable salinity, spring discharge volume sufficient to maintain the appropriate salinity range during both the wet and dry seasons is another major requirement. Very few salt springs may meet this requirement in this region of relatively high precipitation, but qualifying sites merit attention because they may harbor undocumented populations or could become candidate sites for outplanting (Levine et al., 2002).

## IX. NATURE OF THREATS, and PLANNED CONSERVATION and RECOVERY MEASURES

The single known population of *P. howellii* is highly vulnerable primarily due to the fact that it is confined to a single small population adjacent to a major travel corridor and subject to catastrophic events that could eliminate part or all of the population. The species could be considered stable and sustainable only if other populations are discovered in more protected locales or if one or more viable populations are established in protected habitat elsewhere.

Threats, goals, conservation and recovery measures, and specific action items are discussed in the text below, and presented in outline form in Appendix I.

### Threat: Vulnerability to Extinction

**Goal:** Maintain existing population, and ensure viability, integrity, resilience, and persistence of *P. howellii*. This goal will be achieved by implementation of the Conservation Agreement, biannual and as-needed meetings, and timely completion of specific action items. Critical aspects of *P. howellii* life history, reproductive biology, seed viability, habitat requirements, and historical impacts will be documented through preparation of a comprehensive summary of existing species and site information. Critical knowledge gaps will be identified and targeted, and site species inventories will be completed. Monitoring protocols will be

developed to document baseline data and trends, and to detect changes in *P. howellii* distribution, vigor, and habitat. Surveys will be conducted to search for other populations of *P. howellii* or habitat that may be suitable for outplanting. Protocols will be developed to screen, locate and assess suitable sites. Evaluation and implementation of outplantings will be done on a case-by-case basis. Genetic variability of *P. howellii* will be determined with isozyme or DNA analyses. Disturbance to, and protection of, the roadside population will continue to be taken under consideration. Formal seed bank storage will be maintained and expanded, a propagation program will be implemented, and propagated stock will be established for education and outplanting. The cause and significance of large dead patches will be determined through further research, characterization of soils, and mapping and monitoring the patches. *P. howellii* habitat will be restored to the extent feasible as funding allows. A portion of the seed collected each year will be targeted for restoration projects. An outreach program will be developed to prevent or minimize emergency or maintenance impacts.

**Discussion:** Further research regarding the life history and habitat requirements of *P. howellii* is needed to help guide long-term management efforts. Studies completed by Fulgham et al. (1997) should be supplemented by additional research on habitat requirements, reproductive biology, optimal conditions for germination and seedling establishment, effects of seasonal moisture and salinity fluctuations on plant survival, and competitive interactions with other species. The new roadside population provides an excellent empirical study on conditions conducive to establishment and at least short-term survival of the plant. A species management plan should be developed in conjunction with such research including a program for periodic monitoring. Measures to protect *P. howellii* and its habitat should also be incorporated into National Park Service and Caltrans management plans. Conclusive data are not available to indicate whether the population of *P. howellii* is expanding, stable, or declining. The species is challenging to monitor due to the dynamic shifting patches of species over time.

A reliable method, based on detailed habitat characterization, should be developed to screen unoccupied mineral spring habitats elsewhere and rank them with respect to suitability for test plantings of *P. howellii*. Additional field surveys for *P. howellii* should also be conducted. Springs at a greater distance from the type locality than those surveyed to date should be included in the field surveys. Test plantings of *P. howellii* should be considered in other potentially protected mineral springs. Measures to protect *P. howellii* would also protect the mineral springs, a rare community of considerable importance to wildlife and critical habitat for *P. howellii.*

The survival of *P. howellii* and protection of the mineral springs may require implemention of measures to protect the population from impacts due to vehicle accidents and hazardous materials spills that would necessitate intrusive clean-up actions. The highway site is at significant risk because of its proximity to Highway 299 West and complete lack of protection (Figure 9). Drivers often pull over on the large pullout to rest and check their brakes and tires (Figure 10). Numerous tire tracks and litter deposition on or immediately adjacent to, the roadside population have been documented (Figure 11). Additionally, there is potential for an accident involving trucks carrying materials detrimental to vegetation and other biota that would necessitate soil removal or other intrusive clean-up actions that could be catastrophic to the population (Figure 12). Spilled material would flow downslope from Highway 299 West into the springs and then into Willow Creek. Such a significant incident occurred in July 1999, approximately two miles southeast of the *P. howellii* site, when a gasoline tanker spill necessitated the removal of thousands of cubic yards of native material. A similar incident at the *P. howellii* site could be expected to have similar impacts. It should be noted, however, that the curve realignment project by Caltrans in 1992 resulted in a tenfold decrease in accidents at that location (Stacey, 2003).

A roadside barrier and roadside drainage system would prevent hazardous materials from flowing off the highway and onto the springs. Measures to protect *P. howellii* would also protect the mineral springs, a rare community of considerable importance to wildlife and critical habitat for *P. howellii.*

The curve realignment project resulted in the loss of a portion of the *P. howellii* population and its habitat, and the project may have altered the hydrology, including water chemistry, in the area. Mitigation actions required by the U.S. Army Corps of Engineers 404 Permit in the project Mitigation/Monitoring Plan included propagation and replanting of *P. howellii* in Spring 2. These replanted areas flourished for two years and then dwindled, possibly due in part to shifts in the patterns of seepage and salt accumulation, interspecific competition with *D. spicata* and in part for unknown reasons.

Figure 9  Highway population on unprotected wide pullout

Figure 10  Vehicles often impact roadside population

Figure 11 Typical numerous tire tracks through highway population (Spring 2004)


Figure 12 High potential for hazardous spill impacts

Figure 13 Hole dug into *Puccinellia howellii* population

**Threat: Native Invasive Species**

**Goal:** Maintain the mineral springs in a condition that maximizes the ability of *P. howellii* to maintain equilibrium with associated plant species in the mineral springs. Goal will be achieved by conducting research to determine the environmental factors that favor the growth of *Distichlis spicata* and *Triglochin maritima* at the expense of *P. howellii*. Research will include the characterization of soils, hydrology, and water chemistry in areas that favor each species and data accuracy will be verified by test plantings.

**Discussion:** *Puccinellia howellii* and *Distichlis spicata* have different hydrologic preferences that can be utilized for management of the *P. howellii* population in the presence of *D. spicata* (Levine et al., 2002). Optimal control strategies for *Distichlis spicata* outlined by Bacca (1995) may also assist in the management of this species.

**Threat: Exotic Invasive Species**

**Goal:** Reduce and control non-native invasive species. Goal will be achieved by monitoring and treating exotic plant species in and around the *P. howellii* site. A monitoring and control strategy will be developed, based on consultations with experts.

**Discussion:** Exotic plant species are noted in Appendix 2, Species List. Species that have been treated by NPS staff and the working group include *Atriplex rosea, Centaurea solstitialis, Cirsium vulgare, Meliotus alba, and Verbascum thapsus.* Approximately 30 garbage

bags of weeds were hand-pulled by the working group in July 2004. The group plans to meet at least once annually for the purpose of exotic removal.

**Threat: Human Activities**

**Goal:** Identify and mitigate road-related impacts such as roadfill, drainage, toxic runoff, erosion and sedimentation, litter, and emergency response activities. Goal will be achieved by mapping sediment sources, studying effects of runoff, and isolating runoff and potential spills when possible. Measures to minimize impacts from emergency response and recovery will be determined and implemented with development of outreach and education plans.

**Discussion:** Park staff noticed that over the course of the last four years, many large patches of *P. howellii* have died, forming what they term "plaques of death" sites. Park staff previously considered this to be an unknown natural process perhaps created by *P. howellii's* short life span. However, preliminary examination of these types of sites indicates that the dead *P. howellii* patches contain several centimeters of fine-grained sediment overlying the gravel substrate on which the plants originally established. It is possible that once established in relatively dense stands the *P. howellii* plants create a barrier in the sheet flowing water, causing suspended mineral sediment to drop out. *Puccinellia howellii* establishes in coarse gravel substrate that likely has highly oxygenated water flowing through it. However, once fine-grained mineral sediment is deposited, soil properties may change, creating saturated and anaerobic soil conditions around the *P. howellii* root zone, which is distinctly different from the conditions found in the gravels. It is hypothesized that efforts by Caltrans to protect the site with a massive prism of fill (~50-70 feet tall and 120+ feet wide) on the eastern and central portions of the highway, along with high winter precipitation (~60 inches), recharges the fill and has created a new groundwater flow system. This aquifer is composed of recently crushed rock and the groundwater discharging from the fill has high iron concentrations. It is unknown whether the road cut and fill slopes have created an abundance of fine-grained sediment that locally interacts with *P. howellii* stands to create these plaques of death sites, or whether this formation is a natural process.

**Goal:** Pedestrian related impacts will be identified and mitigated. Goal will be achieved by minimizing staff and visitor impacts as much as possible. It is understood that some trampling and/or other damage to *P. howellii* is an inevitable by-product of monitoring and research activities that require multiple incursions into the site.

**Discussion:** Easy access from the highway provides an ideal place for dumping of materials as well as foot traffic from hunters, gold panners, and unknown users. Spring 1 is a popular area for band-

tailed pigeon hunting, as evidenced by the presence of shotgun shells. Also in October 2000, several holes were dug in one of the dense monotypic *P. howellii* population zones in an apparent attempt to mine the area (Figure 13).

**Goal:** Identify and mitigate fire-related impacts. This goal will be achieved by determining fire retardant and foam impacts on *P. howellii*, identifying alternative drafting sites, and developing outreach/education programs.

**Discussion:** Potential suppression impacts include drafting water from the creek, trampling, vehicle use, foam and retardant, mop-up activities and fuel spills.

**Goal:** Identify and mitigate mine-related drainage impacts. This goal will be achieved by investigation and summary of the potential effect of mine-related drainage on *P. howellii* and the mineral springs. Threat level will be determined with onsite review, and effect of flow changes on acid mine drainage (AMD) will be assessed in consultation with appropriate authorities and experts. Clean-up of Greenhorn Mine and Willow Creek will be pursued and AMD effects evaluated in conjunction with hydrological and geochemical research. Former mines in the area of Spring 3 will be investigated, and existing data will be summarized.

**Discussion:** The abandoned Greenhorn Mine, located approximately 4.5 miles west of the *P. howellii* site, encompasses approximately thirty-three acres of underground workings and tailings. Acid mine drainage from springs and seeps at the base of the tailings is an ongoing concern. Water from this mine is discharged into Willow Creek and samples indicate that copper and zinc are at concentrations that are toxic to aquatic life from the mine downstream to the confluence of Willow Creek and Crystal Creek (Department of Water Resources, Northern District 1985). Studies to determine the effects of acid mine drainage on *P. howellii* are warranted since the grass grows along the floodplain of Willow Creek. Two mine adits that were covered by a concrete wall during the 1992 Highway Construction need further investigation.

## X. Follow-up Evaluation and Documentation

Follow-up evaluation and document review meetings will be called at least twice annually and as needed. Each partner will provide status updates, reports and/or a checklist of accomplishments for review. The group will identify next steps, measures that still need to be taken, and discuss monitoring results as well as other pertinent issues. Accomplishment reports will be shared with supporters as appropriate.

## XI. REFERENCES CITED


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## XII. Pertinent Collection Records

CALIFORNIA, Shasta County, Near intersection of State Route 299 West and Crystal Creek Road (all from same locality): 26 Apr 1954, J.T. Howell 29177 (CAS, GH, NY, US); 26 Apr 1954, Rose 54028 (CAS, DS, GH, NY, RSA, WS, WTU); 14 Jun 1955, Howell 30423 (CAS); 21 Jun 1987, Biek 845 (Whiskeytown NRA Herbarium); 24 Jun 1987, Martz s.n. (CAS); 14 Jun 1988, Martz 274 (AHUC, BH, CAS, DAV, HSC, RSA, UC); 26 Jul 1988, Davis 526 (BH, CAS, NY, US); 8 May 1990, Stan W. (Whiskeytown NRA Herbarium); 22 May 1993, Taylor 13491 (JEPS, UC).

## XIII. ATTACHMENTS

Appendix I. Threats, Conservation and Recovery Measures and Action Items in Outline Format

Appendix II. Species List